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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

FORD, JOHN K

ART UNIT

PAPER NUMBER

3784

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/698,179	<b>Applicant(s)</b> KENNY ET AL.	
	<b>Examiner</b> John K. Ford	<b>Art Unit</b> 3784	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 09 November 2010.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1,8-27,29-33,35-130 and 132 is/are pending in the application.
- 4a) Of the above claim(s) 9,11,15,18,20-27,33,35-37,39,42,43 and 45-127 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,8,10,12-14,16,17,19,29-32,38,40,41,44,128-130 and 132 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                       | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. _____                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>1/4/11</u> .  | 6) <input type="checkbox"/> Other: _____                          |

Applicant's response of November 9, 2010 has been carefully considered.

Claims 1, 129 and 132 have been amended. The remainder of the claims have not been amended.

Applicant has elected (now shown in Figure 21) a species of Figures 3A-3B, wherein, instead of microchannel walls 110 as shown in Figure 3B, applicant now has, in Figure 21, replaced those microchannel walls 110, with a porous structure 110' that can be one of sintered metal or silicon foam. Among these two alternatives of material, applicant elected sintered metal.

An action on the merits follows on claims 1, 8, 10, 12-14, 16, 17, 19, 29-32, 38, 40, 41, 44, 128-130 and 132. The remainder of the claims are designated as non-elected or have been canceled.

Applicant has previously concurred with the examiner's statement: "As the examiner understands it, claim 1 is directed to the heat exchanger, per se, while claim 128 is directed to the heat exchanger of claim 1 in combination with a heat source including 'at least one interface hot spot region'".

Applicant's remarks with respect to the allowability of the claims however are not convincing and they are addressed in the rejections that follow.

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The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1, 8, 10, 12-14, 16, 17, 19, 29-32, 38, 40, 41, 44, 128-130 and 132 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Applicant has deleted the word “set” from the claims. The issue of whether or not a “set” can contain only one member as opposed to multiple members is now moot and that aspect of the 35 USC 112, second paragraph, rejection is withdrawn.

Counsel explains that the new wording that has replaced the word “set” is descriptive of the elected species. Specifically, on page 16 of the 11/9/10 response, counsel explains that a first of one or more fingers can be finger 118A, extending in the “x” direction in Figures 3B and 21 and a second of one or more fingers can be 118B and 118C, extending in the “y” direction in Figures 3B and 21. Those two directions (“x” and “y”) are obviously nonparallel. Thus, with regard to claim 1, at least a portion of finger 118A is nonparallel to a portion of fingers 118B and/or 118C.

The recitation in claim 132 that at least one inlet port, inlet channel and first one or more fingers, the second one or more fingers, or both are “substantially in a plane”

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appears to be mis-descriptive. All of these structures are three dimensional and hence, by definition, cannot be “substantially in a plane”. The term “substantially in a plane” in claim 132 is a relative term which renders the claim indefinite. The term “substantially in a plane” is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. In the 11/9/10 response (page 17) counsel states that member 106 is a “planner [sic, planar] structure” and that fact apparently is supposed to make the term “substantially in a plane” definite. The examiner disagrees. Member 106 has a top planar surface 130 and a bottom planar surface 132 as it is shown. There are no limits set on how far apart these two planar surfaces are from one another and hence no limits set on exactly how planar the at least one inlet port, inlet channel and first one or more fingers, the second one or more fingers, or both are with respect to one another. The term “substantially in a plane” remains indefinite.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 8, 10, 12, 13, 14, 17, 19, 32, 38, 40 and 128-130 and 132 are rejected under 35 U.S.C. 103(a) as obvious over the combined teachings of Gruber et al (USP 5,388,635) and Anderson et al (USP 5,761,037).

Gruber, assigned to IBM, shows in Figures 3, 4, 8A and 8B a system for cooling a heat source. An inlet port (analogous to port 108 in applicant's Figure 3b) is shown in Figure 8A at the very top of a cylindrical inlet channel that extends downwardly in Figure 8A. Collectively, the aforementioned inlet port and cylindrical channel below it (hereinafter "inlet port/channel 28") are designated by reference numeral 28 in Gruber. The cylindrical inlet channel directs fluid from the aforementioned inlet port to a first of one or more fingers 30 (for discussion purposes a first finger comprises the topmost finger 30 shown in Figure 8B) and a second of one or more fingers 30 (for discussion purposes a second finger comprises the bottommost finger 30 shown in Figure 8B) that branch out in a plurality of directions from the inlet port and hence are nonparallel.

These fingers 30 feed fluid to channels 32 that, in turn, feed fluid to an intermediate plate 16 that has a plurality of holes extending therethrough. A heat exchanger layer 14 includes micro-fins 56 defining micro-grooves 58 between them similar to applicant's Figure 3A-3B species. As explained by Gruber, the heat exchanger layer 14 can also be "fin-less". See col. 8, line 34-43, incorporated here by reference. If the heat exchanger layer 14 is "fin-less" Gruber states that it may have "a texture or structures to promote fluid stirring and heat transfer". Gruber discusses hot spots in col. 15, lines 1-41, incorporated here by reference.

Anderson, also assigned to IBM, shows a heat source 30 (an integrated circuit “chip”) contacting a conducting portion 104 of a heat exchanger. A heat exchanging layer 103 of sintered copper (a microporous sintered metal according to applicant’s own examples in his own disclosure) is shown and may be bonded to conducting portion 104. An inlet port connected to pipe 21 and an outlet port connected to pipe 11 are shown in Figure 4. While no particular region in Anderson’s integrated circuit chip is disclosed as being hotter than another, arguably applicant’s claim doesn’t even claim an integrated circuit chip so the limitation is not given weight absent a claim to the overall combination. Notwithstanding that fact, it is apparent that the “hot spot region” 104 is cooled far more in the center than right at the edge because of the geometry of the device.

To have combined the teachings of Gruber and Anderson by attaching Anderson’s wicking layer 103 to Gruber’s heat exchanger “fin-less” layer 14 to promote heat transfer particularly when evaporating fluids would have been obvious to one of ordinary skill in the art. Alternatively, to have used Gruber’s fluid distribution system (i.e. everything above sheet 14 in Gruber) in place of the fluid distribution system of Anderson (i.e. everything to the left of sheet 103 in Figures 1 and 2 of Anderson) would have been obvious to one of ordinary skill in the art to advantageously achieve high flows with low pressure drop (a benefit explicitly stated by Gruber).

Regarding claim 10, see the outlet in Figure 4 of Anderson, connected to pipe 11. Also see outlet 46 in Gruber. Regarding claims 12 and 13 fluid inlet and outlet grooves are shown in Gruber. Claim 14, being a method of use limitation in an apparatus claim, is not a limitation on the apparatus itself (for further explanation, see MPEP 2114, incorporated here by reference). Regarding claim 17 there is no overhang shown between the layers in Gruber. Since there is no overhang and applicant's claimed range includes an overhang of "0" (i.e. zero) millimeters, this limitation is met. Regarding claim 32, every porous material by the nature of its formation is formed with irregular pores that inherently vary randomly over the flow path as a consequence of their random orientation. Regarding claims 38 and 40, see Figure 4 of Anderson wherein the body is at least thermally coupled to the integrated circuit chip.

On page 17 of the response of June 1, 2009, counsel contends that the fingers (which the examiner has identified as fingers 30 and are clearly shown in Figures 2, 3 and 8A-8B of Gruber as radiating out from an inlet port and inlet channel collectively shown at 28 in a plurality of different directions before eventually becoming parallel) of Gruber do not branch out in a plurality of directions (citing the language in col. 5, lines 42-44 of Gruber in support of this contention). The language in col. 5, lines 42-44 is in the **"Summary of the Invention"** section of the Gruber specification. Summaries by their nature are inherently broad overviews of the invention and typically do not include the details found in the detailed portion of the disclosure including the drawings. Figure 8B of Gruber shows the two fingers 30 initially radiating from inlet port/channel 28 in two



nearly opposite directions before turning to become parallel and then splitting again in two opposite directions to connect to a channel 32. The first one or more fingers 30 and the second one or more fingers 30 of Gruber definitely meet the “branching” limitations in claim 1. Similarly, more structural depictions of the first and second fingers 30 in Figures 3, 8B and 22 of Gruber all show the first fingers 30 and second fingers 30 radiating out from the inlet port/channel 28 in different directions before eventually turning parallel and then extending in different directions yet again in portions 32 (as shown in Figures 3 and 4).

Turning for a moment to applicant’s own disclosure, applicant’s own fingers 118 and 120 have portions that are parallel to one another very similar to the parallel portions shown in Gruber. Likewise, fingers 118 and 120 of applicant’s disclosure have portions that are not parallel to one another very similar to the non-parallel portions shown in Gruber. It is apparent that counsel’s argument in favor of patentability must fail because the fingers of Gruber and applicant’s own disclosed fingers have portions that extend in different directions and other portions that do not.

The argument that Anderson does not have fingers branching out in different directions is similarly unavailing because Anderson was not relied upon to teach this feature.

In the July 9, 2009 amendment, applicant amended the claims (consistent with the modified specification of December 22, 2008) to specify that fluid flows from an inlet port (108) through an inlet channel (116) through a plurality of fingers (118, 120) through a plurality of conduits (105) extending through an intermediate layer (104) to a heat exchange layer (102). Gruber discloses flow through an inlet port/channel (28, Figures 8A and 8B), through a first one or more fingers (30), a second one or more second fingers (30), through a plurality of conduits (34) extending through an intermediate layer (16) to a heat exchange layer (14).

Fingers 30 of Gruber clearly radiate from inlet port/channel 28 in a plurality of different directions (notwithstanding counsel's incorrect statement that they are "oriented in the same direction" – just look at Figure 8B, showing fingers 30 radiating in a plurality of different directions from port/channel 28 before turning parallel to one another) just as applicant's fingers 118 branch out in a plurality of directions (but also have significant portions of those fingers 118 that are parallel to one another). As the examiner sees it, the inlet port of Gruber is parallel to heat exchange layer 14 of Gruber because one can place a plane across the inlet port in Figure 8A of Gruber that is parallel to surface 60 of heat exchange layer 14. Applicant's argument is incommensurate with the scope of the claim – applicant is not claiming a cylindrical port whose longitudinal axis in the direction of the cylindrical wall is parallel to the heat exchanger layer. Applicant's arguments with respect to Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich all echo the arguments made with respect to Gruber and do not

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traverse that which Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich were relied upon to teach. Accordingly, applicant is deemed to have conceded that Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich are properly relied upon by the examiner for what they have been relied by the examiner to teach.

Claims 1, 8, 10, 12, 13, 14, 17, 19, 32, 38, 40 and 128-130 and 132 are rejected under 35 U.S.C. 103(a) as obvious over the combined teachings of Gruber et al (USP 5,388,635) and Anderson et al (USP 5,761,037) and Chu et al (USP 3,993,123) or Frey et al (USP 5,978,220).

The rejection immediately above is incorporated here by reference. To have made the axis of the longitudinal cylindrical ports/channels 28 and 46 shown in Figures 8A and 8B of Gruber face outwardly in a direction parallel to the cooling surface of the heat exchange layer would have been obvious to one of ordinary skill in the art to advantageously facilitate connection between cold plates, as taught by Chu.

Similarly, to have made the axis of the longitudinal cylindrical ports/channels 28 and 46 shown in Figures 8A and 8B of Gruber face outwardly in a direction parallel to the cooling surface of the heat exchange layer would have been obvious to one of ordinary skill in the art to advantageously facilitate connection between cold plates, as taught by Frey at 5 and 6.

Claims 1, 8, 10, 12, 13, 14, 17, 19, 32, 38, 40, 128-130 and 132 are rejected under 35 U.S.C. 103(a) as obvious over the combined teachings of Gruber/Anderson or Gruber/Anderson/Chu/Frey as applied to claims 1, 8, 10, 12, 13, 14, 17, 19, 32, 38, 40 128-130 and 132 above and further in view of either Hou (USP 5,983,997) or Messina et al (USP 5,239,200).

Hou teaches forming different flow channel structures to provide different cooling rates to different parts of the heat transfer surface. Messina teaches the same thing in regard to the explanation of Figure 5, incorporated here by reference. In view of either of these teachings it would have been obvious to have structured the passageways and flow rates in Gruber/Anderson to concentrate cooling in certain areas of high heat load.

In response to applicant's November 9, 2010 remarks, the examiner's explanation, above, of how the fingers of Gruber branch out in a plurality of directions from the at least one inlet port/channel of Gruber is incorporated here by reference.

Applicant's arguments with respect to Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich all echo the arguments made with respect to Gruber and do not traverse that which Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich were relied upon to teach. Accordingly, applicant is deemed to have conceded that Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich are properly relied upon by the examiner for what they have been relied by the examiner to teach.

Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gruber/Anderson alone or Gruber/Anderson/Chu/Frey alone or in view of Hou or Messina as applied to claim 1 above, and further in view of Herrell (USP 4,758,926).

The thickness of layer 104 is not disclosed in Anderson. Gruber discloses a thickness of 375 micrometers (col. 12, line 59) which is 0.375 mm (within applicant's range of 0.3 to 0.7mm).

In Herrell layer 40 is 25 mils thick. Each mil is 25.4 microns. Layer 40 is therefore 635 microns thick. 635 microns is 0.635 millimeters, within applicant's claimed range. To have made the layer 104 of Anderson .635 millimeters thick (when used with Gruber's fluid distribution system) as taught by Herrell would have been obvious since it is shown by Herrell to be a dimension that works. Similarly to have made the same layer 0.375 mm as taught by Gruber because it also works would have been obvious to one of ordinary skill in the art.

In response to applicant's November 9, 2010 remarks, the examiner's explanation, above, of how the fingers of Gruber branch out in a plurality of directions from the at least one inlet port/channel of Gruber is incorporated here by reference.

Applicant's arguments with respect to Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich all echo the arguments made with respect to Gruber and do not traverse that which Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich were relied upon to teach. Accordingly, applicant is deemed to have conceded that Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich are properly relied upon by the examiner for what they have been relied by the examiner to teach.

Claims 29-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gruber/Anderson alone or Gruber/Anderson/Chu/Frey alone or in view of Hou or Messina as applied to claim 1 above, and further in view of Tonkovich (USP 6,680,044).

As disclosed the porosity of the porous microstructure should be such that heat exchange medium flows freely. With respect to claims 29-30 applicant has shown no criticality whatsoever and the art recognized tradeoff between getting adequate heat transfer and avoiding excessive pressure drop suggests that the variables being claimed are ultimately for the designer to select in any given heat transfer application. To have configured the porous intermediate layer of Anderson with a porosity that is known to provide good fluid flow as taught by Tonkovich in col. 2, lines 50-63, incorporated here by reference (teaching a porosity within applicant's claimed range as well as pore sizes in applicant's claimed range and a channel height with applicant's claimed range), would have been obvious to one of ordinary skill in the art to advantageously obtain extremely even cooling without any temperature gradients.

In response to applicant's November 9, 2010 remarks, the examiner's explanation, above, of how the fingers of Gruber branch out in a plurality of directions from the at least one inlet port/channel of Gruber is incorporated here by reference.

Applicant's arguments with respect to Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich all echo the arguments made with respect to Gruber and do not traverse that which Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich were relied upon to teach. Accordingly, applicant is deemed to have conceded that Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich are properly relied upon by the examiner for what they have been relied by the examiner to teach.

Claims 1, 8, 10, 12, 13, 14, 17, 19, 29, 30, 31, 32, 38, 40, 128-130 and 132 are rejected under 35 U.S.C. 103(a) as obvious over Gruber et al (USP 5,388,635) in view of the Jiang et al article "Thermal-Hydraulic performance of small scale micro-channel and porous-media heat exchangers".

Gruber, assigned to IBM, shows in Figures 3, 4, 8A and 8B a system for cooling a heat source. An inlet port (analogous to port 108 in applicant's Figure 3b) is shown in Figure 8A at the very top of a cylindrical inlet channel that extends downwardly in Figure 8A. Collectively, the aforementioned inlet port and cylindrical channel below it are designated by reference numeral 28 in Gruber. The cylindrical inlet channel directs fluid

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from the aforementioned inlet port to a first of one or more fingers 30 (for discussion purposes a first finger comprises the topmost finger 30 shown in Figure 8B) and a second of one of more fingers 30 (for discussion purposes a second finger comprises the bottommost finger 30 shown in Figure 8B) that branch out in a plurality of directions from the inlet port and hence are nonparallel.

These fingers 30 feed fluid to channels 32 that, in turn, feed fluid to an intermediate plate 16 that has a plurality of holes extending therethrough. A heat exchanger layer 14 includes micro-fins 56 defining micro-grooves 58 between them similar to applicant's Figure 3A-3B species. As explained by Gruber, the heat exchanger layer 14 can also be "fin-less". See col. 8, line 34-43, incorporated here by reference. If the heat exchanger layer 14 is "fin-less" Gruber states that it may have "a texture or structures to promote fluid stirring and heat transfer". Gruber discusses hot spots in col. 15, lines 1-41, incorporated here by reference.

The Jiang article discloses the art recognized equivalence of microchannel structures 56 and 58 of Gruber and porous microstructures as claimed by applicant currently. To have made the microchannel structures 56 and 58 of Gruber of microporous media as taught by the Jaing article would have been obvious to one of ordinary skill in the art. In general the microporous media is advantageous in terms of having better heat transfer than the microchannel structures 56 and 58 of Gruber as would have been obvious to have used for that reason in spite of their somewhat higher pressure drop (as disclosed explicitly in the Jaing article).



Regarding claim 8, the inlet port 28 and outlet port 46 are parallel to a plane. Regarding claim 13, grooves (i.e. long narrow channels) are shown in Gruber channeling fluid from one of the inlet and outlet to the fingers. Claim 14, is satisfied because Gruber does not disclose any boiling or vaporization of the heat exchange fluid. Alternatively claim 14, being a method of use limitation in an apparatus claim is not a limitation on the apparatus itself (for further explanation, see MPEP 2114, incorporated here by reference). Regarding claim 17, in Gruber there is no overhang shown in Figures 13-15. Since there is no overhang and applicant's claimed range includes an overhang of "0" (i.e. zero) millimeters, this limitation is met by Gruber. Regarding claim 19, while the preferred material of manufacture in Gruber is metal and the metals listed in column 13, lines 3-14 have a higher conductivity than silicon, which is approximately 120 W/mK and can be looked up in standard handbooks, so claim 19 is met by Gruber. Metals, such as copper explicitly disclosed in Gruber, have an extremely high conductivity.

In response to applicant's November 9, 2010 remarks, the examiner's explanation, above, of how the fingers of Gruber branch out in a plurality of directions from the at least one inlet port/channel of Gruber is incorporated here by reference.

Applicant's arguments with respect to Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich all echo the arguments made with respect to Gruber and do not traverse

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that which Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich were relied upon to teach. Accordingly, applicant is deemed to have conceded that Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich are properly relied upon by the examiner for what they have been relied by the examiner to teach.

Claims 1, 8, 10, 12, 13, 14, 17, 19, 29, 30, 31, 32, 38, 40, 128-130 and 132 are rejected under 35 U.S.C. 103(a) as obvious over Gruber et al (USP 5,388,635) in view of the Jiang et al article "Thermal-Hydraulic performance of small scale micro-channel and porous-media heat exchangers" and Chu et al (USP 3,993,123) or Frey et al (USP 5,978,220).

The rejection immediately above is incorporated here by reference. To have made the axis of the cylindrical ports/channels 28 and 46 shown in Figures 8A and 8B of Gruber face outwardly in a direction parallel to the cooling surface of the heat exchange layer as taught by Chu would have been obvious to one of ordinary skill in the art to advantageously facilitate connection between cold plates.

Similarly, to have made the axis of the longitudinal cylindrical ports/channels 28 and 46 shown in Figures 8A and 8B of Gruber face outwardly in a direction parallel to the cooling surface of the heat exchange layer would have been obvious to one of ordinary skill in the art to advantageously facilitate connection between cold plates, as taught by Frey at 5 and 6.

Claims 1, 8, 10, 12, 13, 14, 16, 17, 19, 29, 30, 31, 32, 38, 40, 128-130 and 132 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gruber in view of O'Neill et al (USP 4,896,719) and Tonkovich (USP 6,680,044).

Gruber, assigned to IBM, shows in Figures 3, 4, 8A and 8B a system for cooling a heat source. An inlet port (analogous to port 108 in applicant's Figure 3b) is shown in Figure 8A at the very top of a cylindrical inlet channel that extends downwardly in Figure 8A. Collectively, the aforementioned inlet port and cylindrical channel below it are designated by reference numeral 28 in Gruber. The cylindrical inlet channel directs fluid from the aforementioned inlet port to a first of one or more fingers 30 (for discussion purposes a first finger comprises the topmost finger 30 shown in Figure 8B) and a second of one of more fingers 30 (for discussion purposes a second finger comprises the bottommost finger 30 shown in Figure 8B) that branch out in a plurality of directions from the inlet port and hence are nonparallel.

These fingers 30 feed fluid to channels 32 that, in turn, feed fluid to an intermediate plate 16 that has a plurality of holes extending therethrough. A heat exchanger layer 14 includes micro-fins 56 defining micro-grooves 58 between them similar to applicant's Figure 3A-3B species. As explained by Gruber, the heat exchanger layer 14 can also be "fin-less". See col. 8, line 34-43, incorporated here by reference. If the heat exchanger layer 14 is "fin-less" Gruber states that it may have "a

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texture or structures to promote fluid stirring and heat transfer". Gruber discusses hot spots in col. 15, lines 1-41, incorporated here by reference.

To have replaced the microchannel layer 14 of Gruber with the corresponding porous layer construction of O'Neill (i.e. skin 15 and adjoining expanded foam 25) would have been obvious to one of ordinary skill in the art to advantageously obtain extremely even cooling without any temperature gradients as would occur when there were discrete heat transfer zones as is the case in Gruber. Note that porous microstructures have better heat transfer characteristics than microchannels as evidenced by Jiang et al article "Thermal-Hydraulic performance of small scale micro-channel and porous-media heat exchangers." Here the Jaing article is only relied upon to show an inherent property of porous microstructures compared to microchannels.

As disclosed the porosity of the expanded foam should be such that heat exchange medium flows freely. With respect to claims 29-30 applicant has shown no criticality whatsoever and the art recognized tradeoff between getting adequate heat transfer and avoiding excessive pressure drop suggests that the variables being claimed are ultimately for the designer to select in any given heat transfer application. To have configured the porous intermediate layer of Gruber/O'Neill with a porosity that is known to provide good fluid flow as taught by Tonkovich in col. 2, lines 50-63, incorporated here by reference, would have been obvious to one of ordinary skill in the

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art to advantageously obtain extremely even cooling without any temperature gradients as would occur when there were discrete heat transfer zones as is the case in Gruber.

In response to applicant's November 9, 2010 remarks, the examiner's explanation, above, of how the fingers of Gruber branch out in a plurality of directions from the at least one inlet port/channel of Gruber is incorporated here by reference.

Applicant's arguments with respect to Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich all echo the arguments made with respect to Gruber and do not traverse that which Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich were relied upon to teach. Accordingly, applicant is deemed to have conceded that Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich are properly relied upon by the examiner for what they have been relied by the examiner to teach.

Claims 1, 8, 10, 12, 13, 14, 16, 17, 19, 29, 30, 31, 32, 38, 40, 128-130 and 132 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gruber in view of O'Neill et al (USP 4,896,719) and Tonkovich (USP 6,680,044) and Chu et al (USP 3,993,123) or Frey (USP 5,978,220).

The rejection immediately above is incorporated here by reference. To have made the axis of the cylindrical ports/channels 28 and 46 shown in Figures 8A and 8B of Gruber face outwardly in a direction parallel to the cooling surface of the heat

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exchange layer as taught by Chu would have been obvious to one of ordinary skill in the art to advantageously facilitate connection between cold plates.

Similarly, to have made the axis of the longitudinal cylindrical ports/channels 28 and 46 shown in Figures 8A and 8B of Gruber face outwardly in a direction parallel to the cooling surface of the heat exchange layer would have been obvious to one of ordinary skill in the art to advantageously facilitate connection between cold plates, as taught by Frey at 5 and 6.

Claims 41 and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over any of the prior art references as applied to claim 1 above, and further in view of Cardella (USP 5,918,469) or WO 01/25711 A1 (cited by applicant).

Cardella teaches a thermoelectric cooler 24 between a heat source (an integrated circuit chip 22) and a liquid-coolant type heat exchanger 20. To have inserted a thermoelectric cooler between each of the integrated circuits of Gruber (in combination with the other prior art discussed above) and the bottom layer of Gruber (in combination with the other prior art discussed above) to advantageously cool the integrated circuits even more would have been obvious to one of ordinary skill in the art in view of Cardella. Alternatively, to have replaced heat exchanger 20 of Cardella with the microchannel heat sink assembly described in the above rejections to

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advantageously improve cooling in Cardella would have been obvious to one of ordinary skill in the art.

Finally, to have replaced either or both of the heat sink assemblies of WO 01/25711 A1 (cited by applicant) best seen in Figure 2 (18 and 19 at the bottom and 15 and 16 at the top) with the heat sink assembly of Gruber (in combination with the other prior art discussed above) would have been obvious to one of ordinary skill in the art to improve the cooling performance by advantageously reducing the length of the fluid flow paths.

In response to applicant's November 9, 2010 remarks, the examiner's explanation, above, of how the fingers of Gruber branch out in a plurality of directions from the at least one inlet port/channel of Gruber is incorporated here by reference.

Applicant's arguments with respect to Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich all echo the arguments made with respect to Gruber and do not traverse that which Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich were relied upon to teach. Accordingly, applicant is deemed to have conceded that Andersen, Hou, Messina, Jaing, O'Neill, and Tonkovich are properly relied upon by the examiner for what they have been relied by the examiner to teach.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John K. Ford whose telephone number is 571-272-4911. The examiner can normally be reached on Mon.-Fri. 9-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Frantz Jules can be reached on 571-272-4834. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.



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/John K. Ford/  
Primary Examiner, Art Unit 3784